COMPREHENSIVE PLANNING ORGANIZATION

THE REGIONAL MODEL SYSTEM

AND THE PLANNING/DECISION MAKING PROCESS; *A Non–Technical Description*

SAN DIEGO CALIFORNIA

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April, 1972

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FOREWORD

The "Regional Models System" brochure was accomplished as part of the overall regional planning program of the San Diego Comprehensive Planning Organization (CPO).

CPO is a voluntary association of local governments formed to assure sound overall areawide planning for the San Diego County Region. Members include cities of Carlsbad, Chula Vista, Coronado, Del Mar, El Cajon, Escondido, Imperial Beach, La Mesa, National City, Oceanside, San Diego, San Marcos, and Vista.

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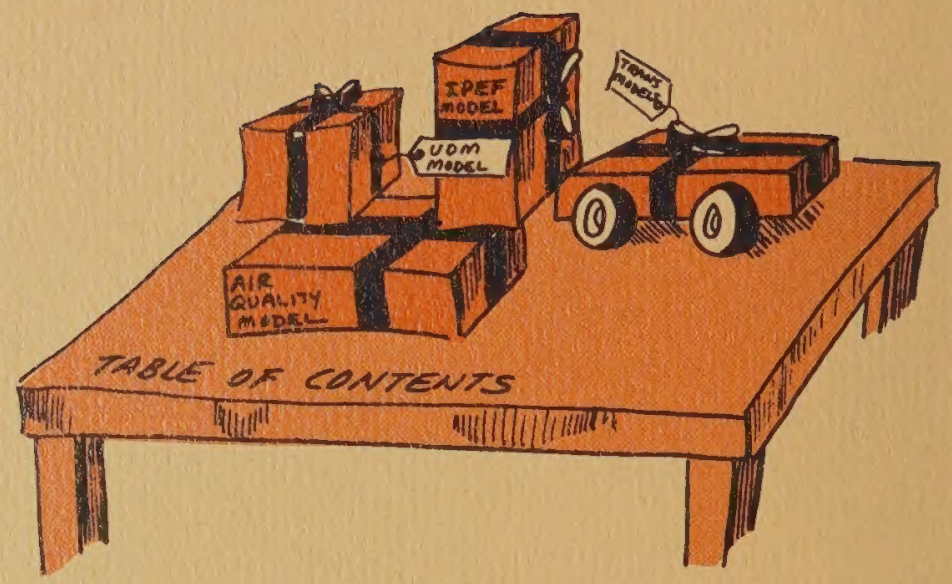
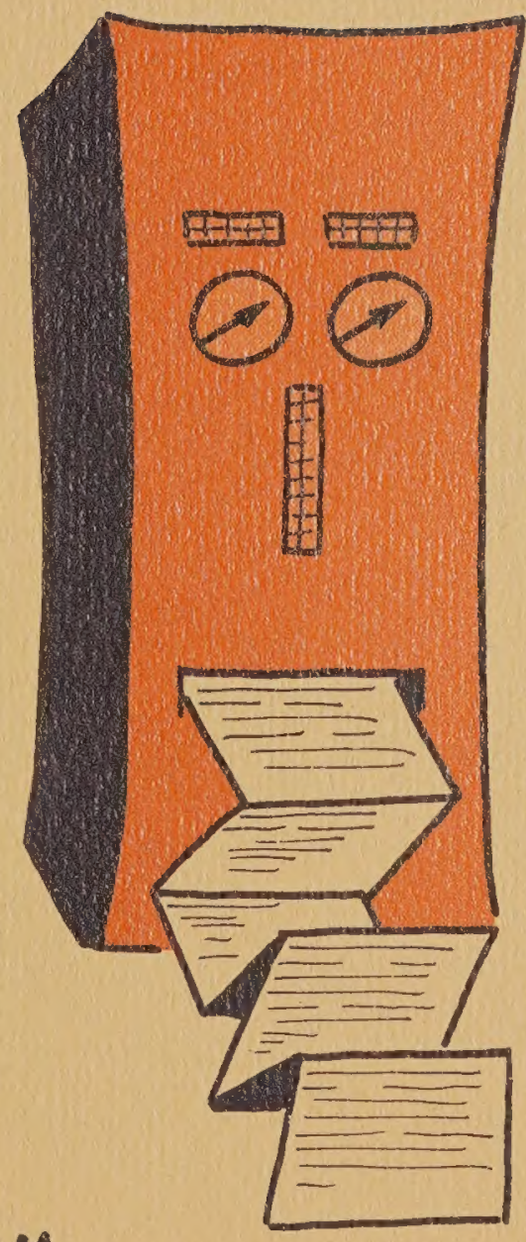


INTRODUCTION

The San Diego County Comprehensive Planning Organization is sponsoring an ambitious program to develop and implement a comprehensive regional plan. To carry out this work many advanced techniques are being employed, including extensive use of computer models. These models are vital to the preparation of a regional plan. To people outside of the planning profession, computer models are often little understood or viewed as some kind of mystical black box spewing out wisdom. This report is intended to clear up some of the mystery surrounding models, especially the models used in the regional planning program. One important point should be kept in mind throughout this report -- MODELS DO NOT MAKE DECISIONS -- but they aid in measuring and evaluating alternative solutions and their implications.



A MODEL IS NOT A
MYSTICAL BLACK BOX
SPEWING OUT WISDOM

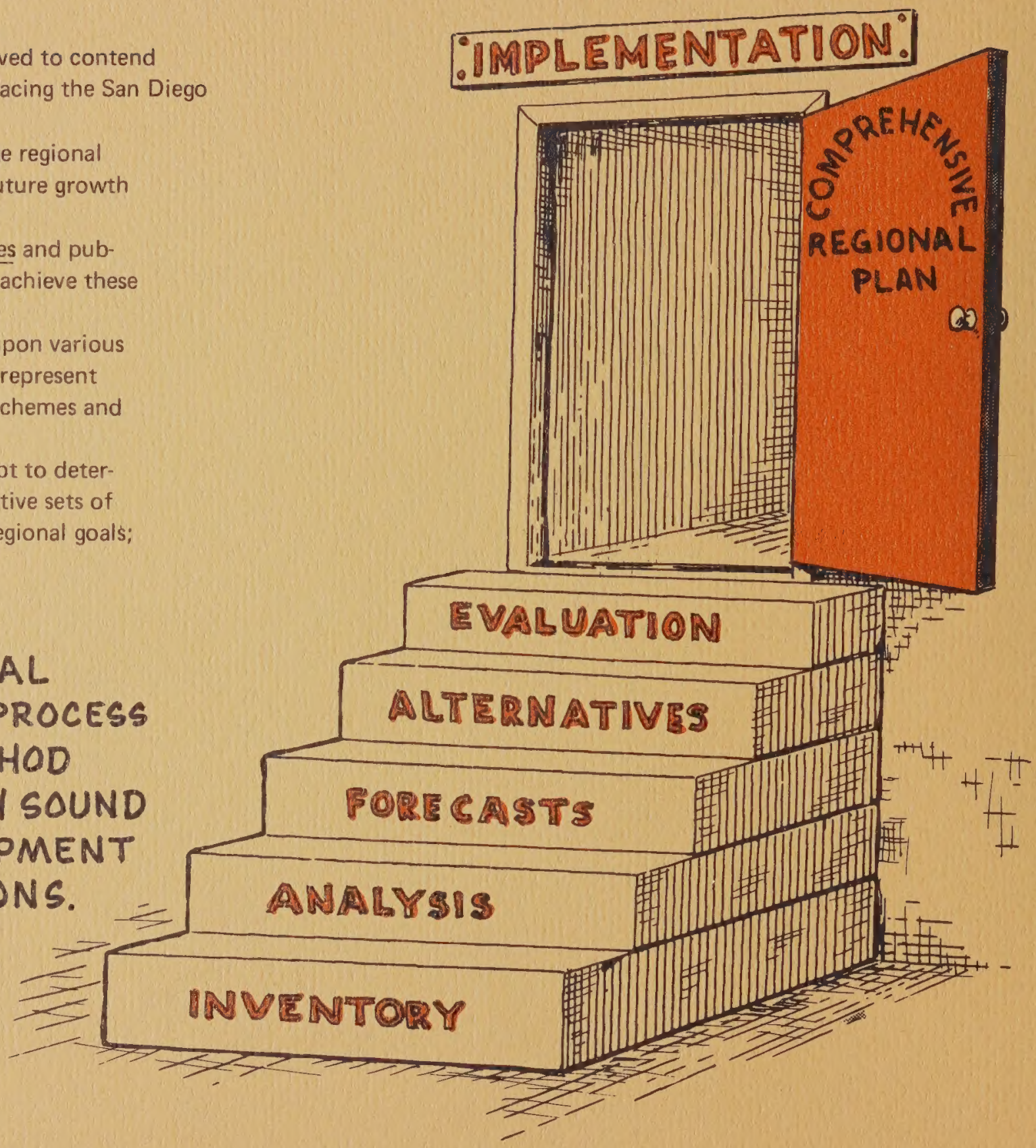
The regional planning process which has evolved to contend with the many complex development issues facing the San Diego Region involves the following nine steps:

(1) Identify a set of broad long-range regional goals and objectives for sound future growth and development;

(2) Specify alternative sets of policies and public actions which can be used to achieve these goals;

(3) Develop a series of plans based upon various combinations of policies, which represent alternative future development schemes and transportation systems;

(4) Test each alternative plan concept to determine the effectiveness of alternative sets of policies in achieving particular regional goals;



THE REGIONAL PLANNING PROCESS IS A METHOD TO REACH SOUND DEVELOPMENT DECISIONS.

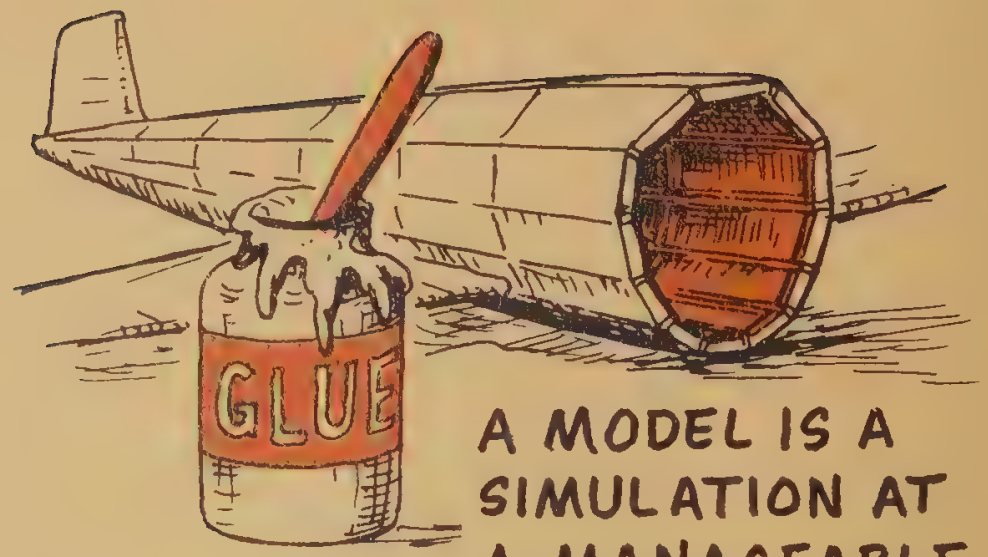
(5) Identify desirable and objectionable aspects of each alternative plan;
(6) Evaluate each alternative plan for effectiveness, feasibility and cost;
(7) Choose or select a particular alternative and its related set of policies;
(8) Articulate an implementation plan which would utilize public facilities and services and development controls to achieve the desired plan form;
(9) Monitor actual growth and development as it occurs and relate this activity to the goals of the regional plan.

Computer models, as they are being developed and used in the regional planning program, perform a very basic and vital set of functions. They are the principle tools used to translate alternative sets of policies into future land use and transportation patterns. These models represent the development and application of the most sophisticated tools and analytical techniques currently available to the problem of preparing a comprehensive plan for the San Diego Region.

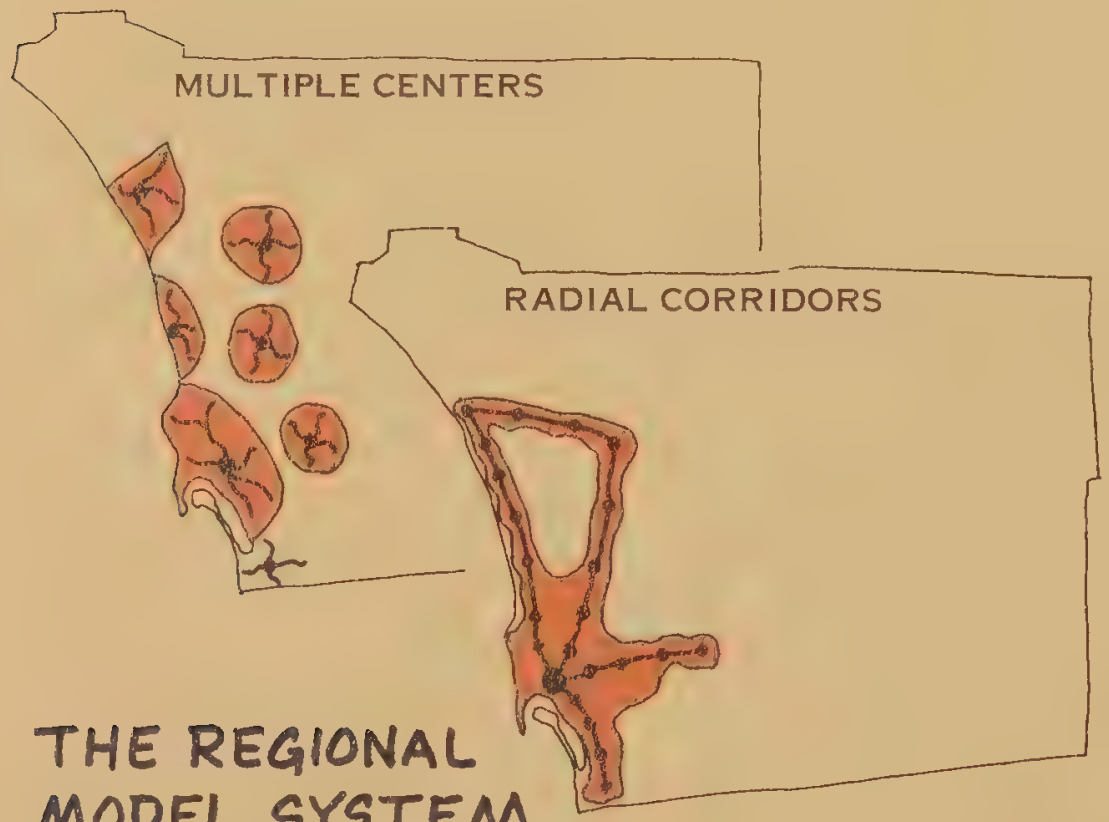
PLANNING MODELS OFFER MORE ACCURATE AND COMPLETE INFORMATION UPON WHICH ALTERNATIVE PLANS CAN BE EVALUATED.

WHAT IS A MODEL?

Webster's Dictionary defines the term 'model' as 'a set of plans, a copy, a facsimile, or a pattern'. Architects, for example, often rely upon three dimensional clay models to gain a better feeling for how a particular site will look with different types of buildings, streets, plantings and open space. Although these clay models are oversimplifications of the real world, they are extremely valuable. They enable the professional architect and his client to view alternative proposals and to evaluate them based upon a more visible indication of how it will look once constructed.



A MODEL IS A SIMULATION AT A MANAGEABLE SCALE



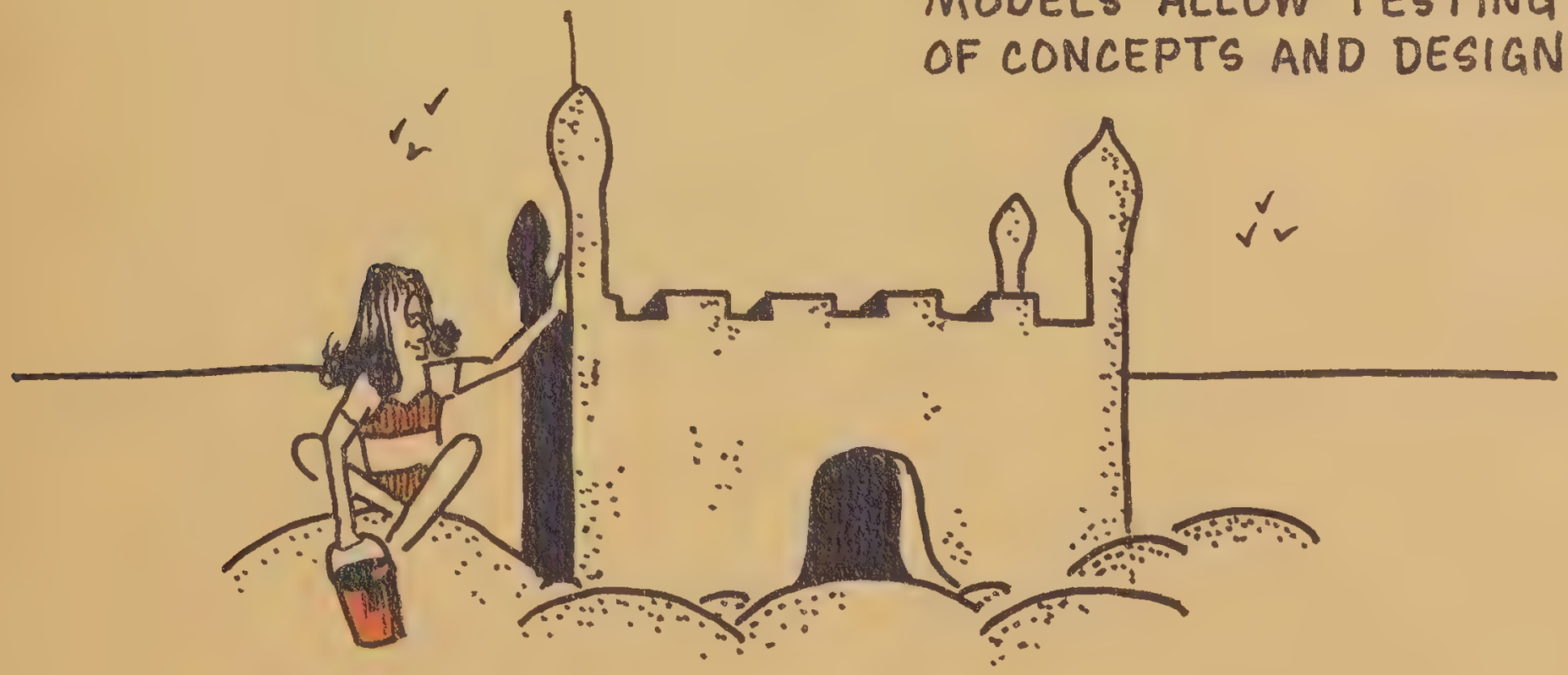
THE REGIONAL MODEL SYSTEM TRANSLATES POLICIES INTO ALTERNATIVE PLANS

Models, particularly in the field of planning, are often expressed in 'non-physical' or mathematical terms. The form that a mathematical model might take can be illustrated by the following example. Economists tell us that, other forces being equal, the demand for a particular product (an ice cream cone for example) is directly related to the price that the product sells for. Specifically, as the price for ice cream goes down, the more cones an individual will purchase. Suppose that observations of a particular individual reveals that his consumption of ice cream cones per week varies with price as shown below:

PRICE OF CONES	QUANTITY PURCHASED PER WEEK
$ .30	2
$ .25	4
$ .20	6

With this information, it is possible to observe a sample mathematical relationship between price and demand. With this relationship in mind, it is possible to predict that if the cost of an ice cream cone were to drop to $.15 each, the quantity demanded would increase to 8 per week.

Although this example is over simplified, it serves to illustrate how a model can be expressed in mathematical terms. Like the architects' clay model, this mathematical model is an oversimplification of the real world. However, each type of model can provide valuable information to both the professional and the client.



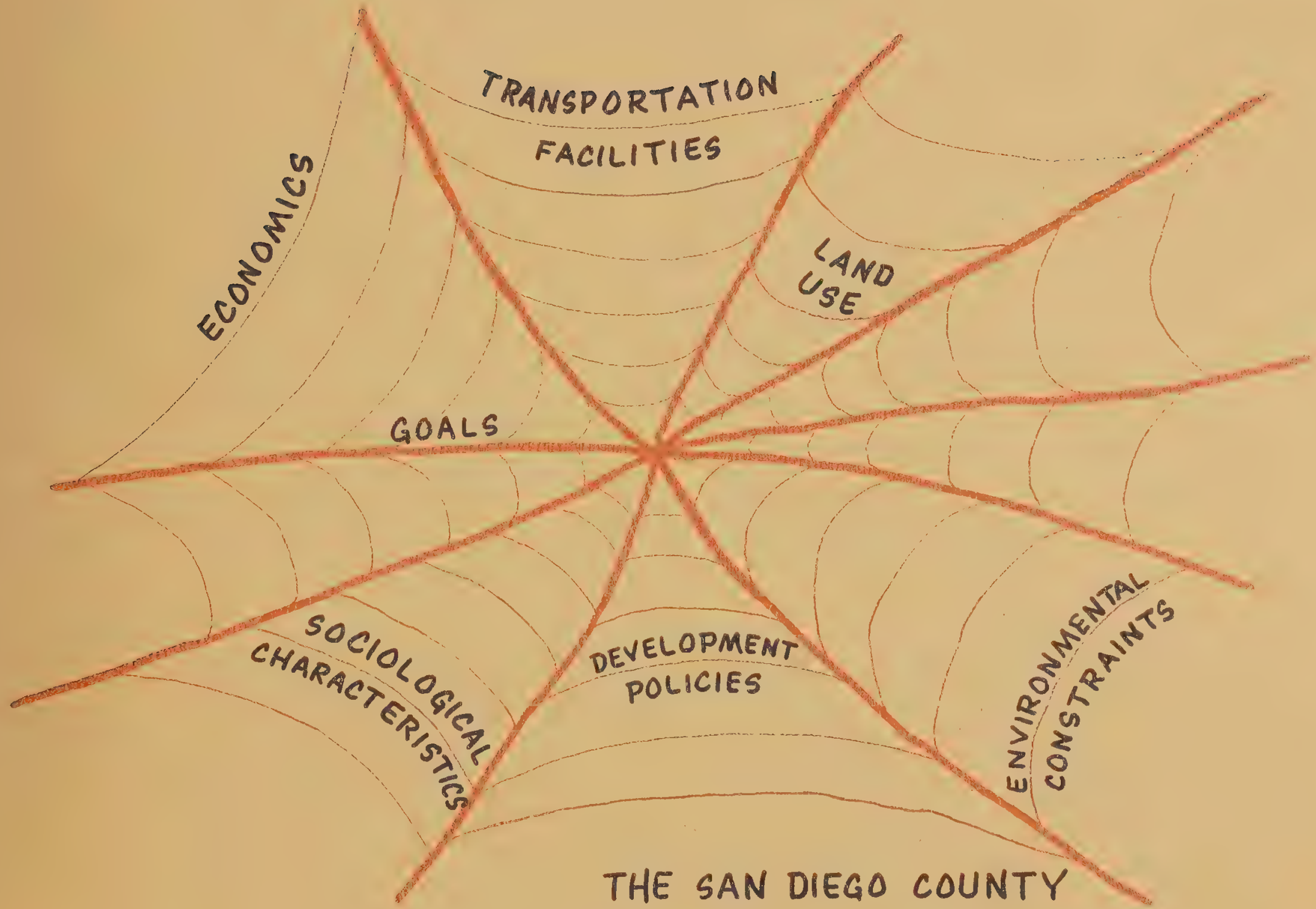
WHY USE A COMPUTER?

The answer is certainly not that computers are wiser than their masters, but rather that they can perform the most monotonous and repetitive tasks with high speed and mechanical accuracy. By charging the computer with this responsiblity, both the professional planner and the decision maker is freed to focus attention on the problem of identifying different policies and conceptualizing alternative futures.

The regional model system is able to account for a variety of interrelationships which are difficult or impossible to consider without the aid of this valuable tool. These interrelationships include such measures as:

(1) The effects of sewer and water facilities upon the potential for residential development;
(2) The effects of alternative forms of transportation upon the distribution and density of future populations;
(3) The effects of alternative development controls, residential densities, and open space policies upon overall growth patterns;
(4) The impact of population densities upon the demand for mass transit; and
(5) The influence of future transportation patterns upon regional air quality.

COMPUTERS AID PRIMARILY IN UNDERTAKING THOSE TASKS WHICH ARE MONOTONOUS AND REPETITIVE.



THE SAN DIEGO COUNTY REGION IS A COMPLEX WEB OF INTERRELATIONSHIPS

WHY USE MODELS?

The process of developing computer models is often time consuming and expensive. Not only do intricate mathematical relationships need to be defined and computer programs written, but large amounts of data must be gathered. So why bother with models?

First of all, planning models provide the capability to accurately account for the varied and complex forces that are at work within the social, economic and physical aspects of the regional environment. The regional model system is the principle tool that will be used to account for these forces in preparing a regional plan.

Second, a computer model is very useful in providing decision makers with answers to 'what if.....?' questions.

'What if a new freeway is built?'
'What if the airport is moved to the suburbs?'
'What if a large industrial firm is forced to close its doors?'

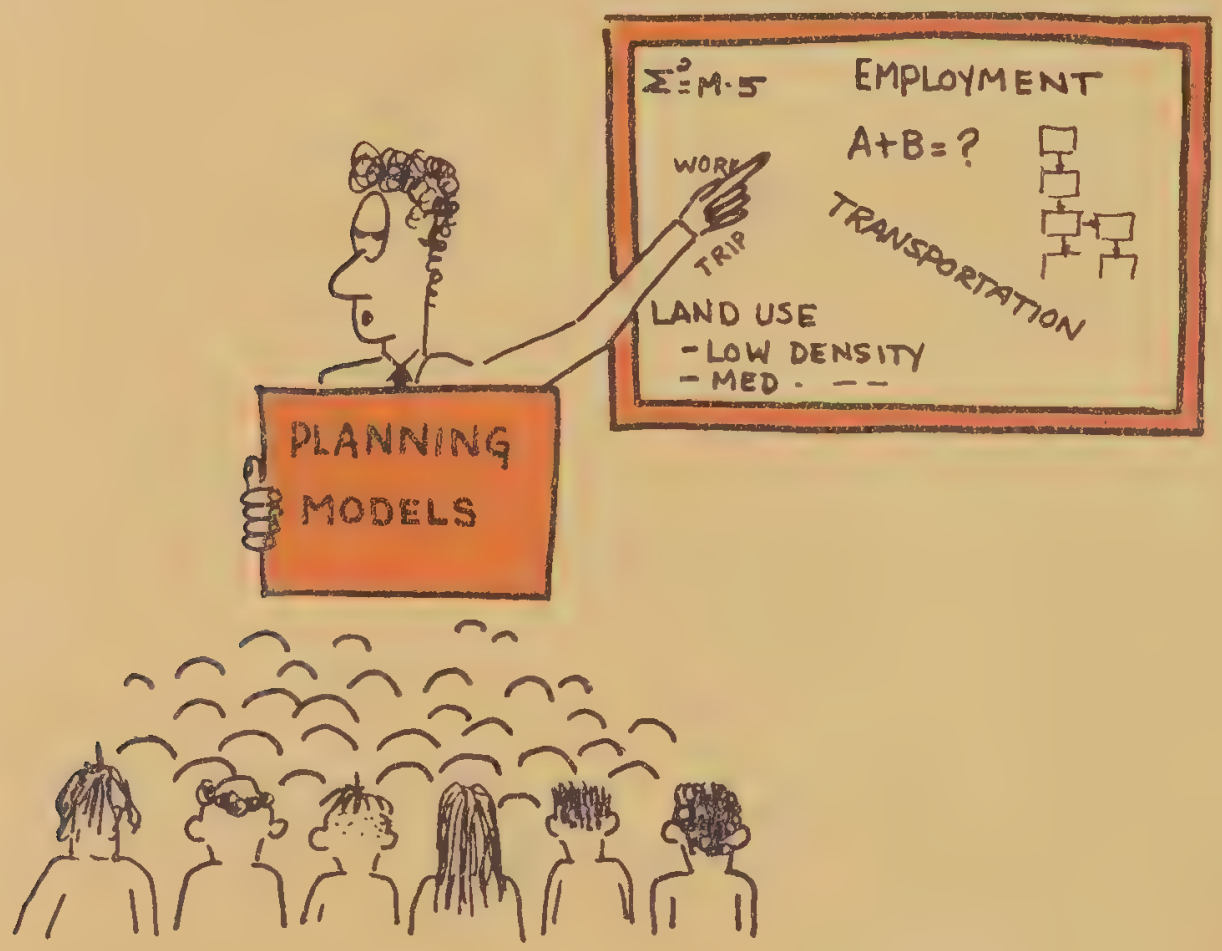
Although a model will not provide all the answers, it can provide valuable insights into many important questions. And because it is computerized, it can respond quickly and accurately. These accurate assessments of alternative policy decisions will help to insure that the probable effects of these decisions are fully understood. More importantly, costly and ill-informed development decisions can be avoided in the future.

MODELS CAN BE USED TO TEST THE EFFECTS OF DIFFERENT POLICY CHOICES

Third, in order to be effective, the planning process must identify existing and future problems and offer alternative solutions. For example, through the proper application of land use-transportation models, it is possible to determine the adequacy of proposed transportation systems to handle probable future travel demands. Moreover, these models can provide indications of the effectiveness of various techniques in achieving desired population and land use distribution patterns and meeting regional goals. Based upon the insights derived through the application of these tools, it is possible to conceptualize and test various policies which can be designed to overcome many of these difficulties. Moreover, they will greatly aid in foreseeing problems before they occur.

PLANNING MODELS ARE HELPFUL IN IDENTIFYING POTENTIAL FUTURE PROBLEMS

A fourth function of models--one that is often underestimated or overlooked completely--is their educational value. The process of developing a model demands rigorous analysis. Relationships must be stated precisely and assumptions specified clearly. This rigor forces the model-builder to recognize things that might otherwise go unnoticed. Once the model is developed, it enables the planner to study the important interrelationships without getting bogged down in a mass of detail.



PLANNING MODELS HAVE EDUCATIONAL VALUE

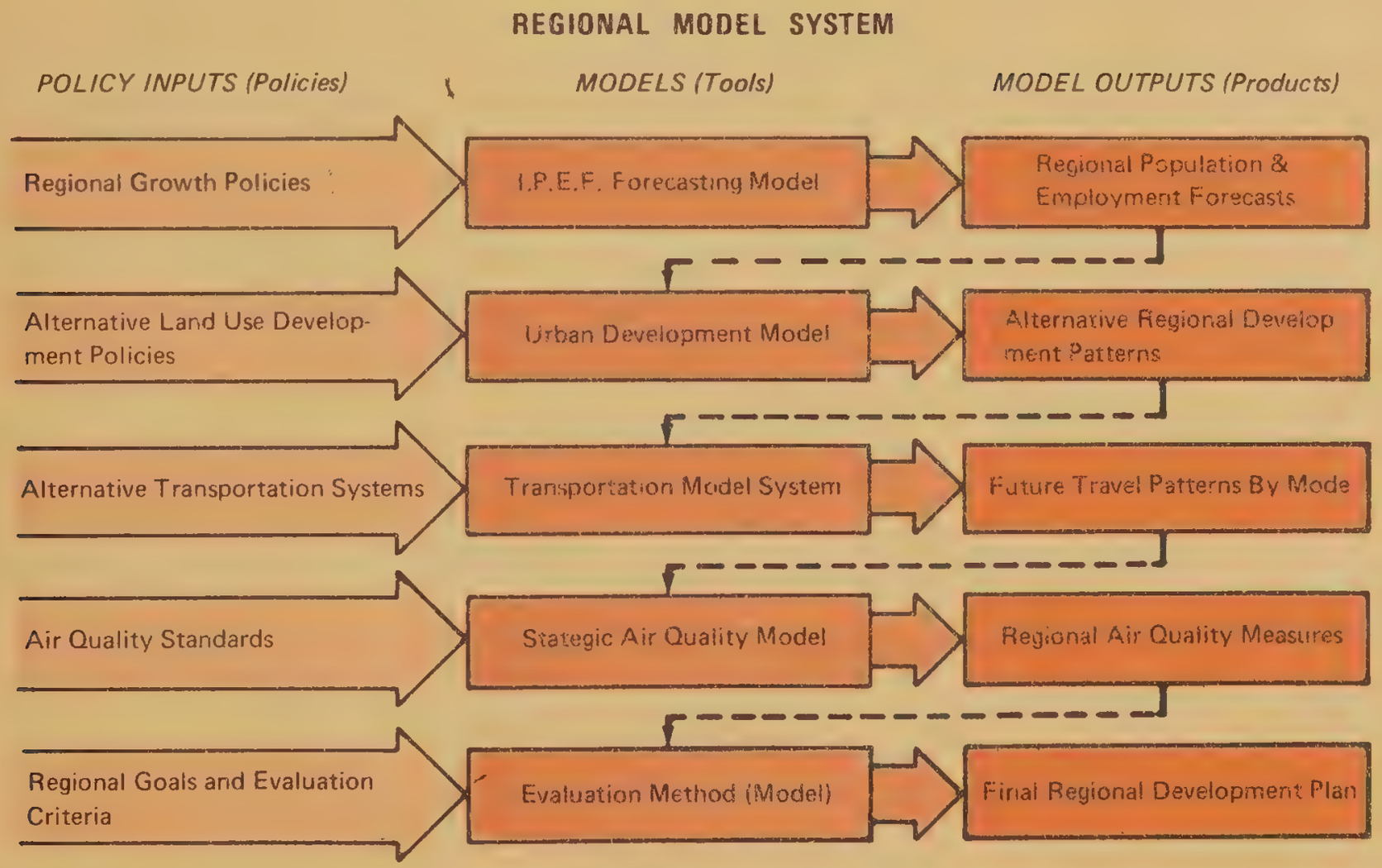
WITHOUT MODELS INTUITIVE JUDGEMENT MAY BE REQUIRED.

The advantages of using computer models can be seen by looking at the traditional non-model approach to planning. Without models the planner is forced to rely heavily upon intuitive judgement. With little or no analytical framework for analysis, many important interrelationships go unnoticed. Unlike the traditional planning approach, plans can be quickly revised as conditions and assumptions chang through the use of planning models.

THE REGIONAL MODEL SYSTEM

The regional planning program relies heavily on the use of models. A number of models have been, or are being developed, each addressing a particular aspect of the regional environment. The models can be used independently to analyze a particular situation or problem, or because of the built-in linkages between the models, they can be viewed as a system. When viewed in this manner, the regional models constitute a sequence which allows information produced by one model to flow to the next.

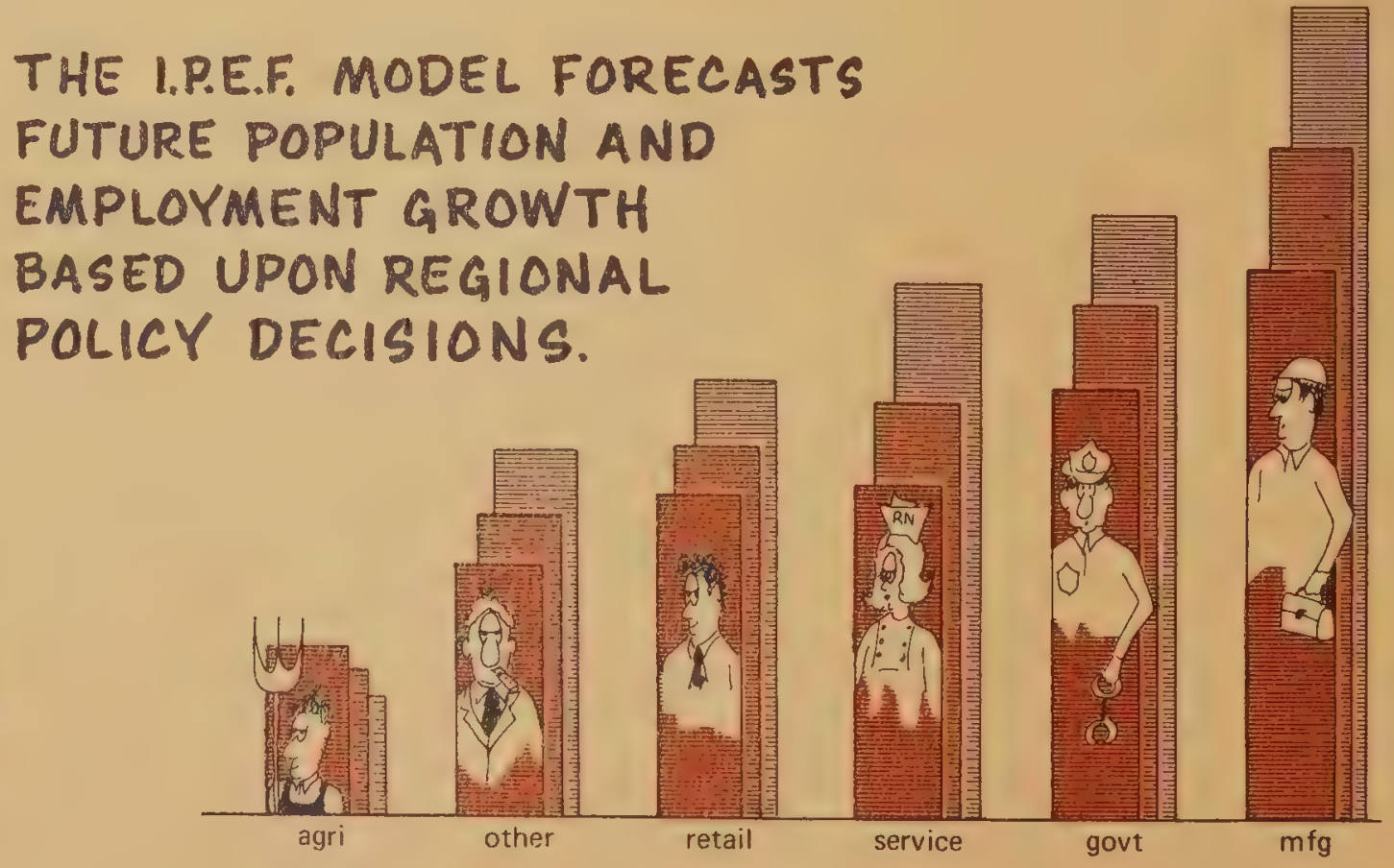
The following discussion describes each of the major models currently being used, or scheduled for use, in the regional planning program. An attempt is also made to indicate how each model relates to the overall model system and to the regional planning program. This discussion is intended to be an overview of the model system and avoids reference to any detailed technical considerations.



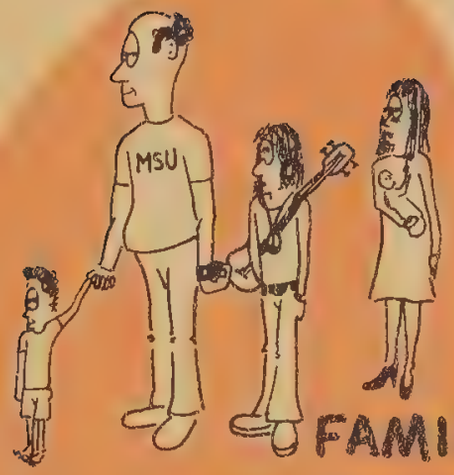
INTERACTIVE POPULATION/EMPLOYMENT FORECASTING MODEL (IPEF)

The IPEF model produces long-range forecasts of total regional population and employment based upon regional policy decisions. It provides a detailed age, race, and sex breakdown of the forecasted population, and a breakdown of employment by detailed industry categories. The IPEF model, as developed by the Research and Information Systems staff, was designed to be a versatile forecasting tool. It has been applied in a variety of ways to the question of determining future population levels for the San Diego Region. As a result of this initial application, it was found that the population of the San Diego Region in 1995 could range from 1.9 to 2.7 million people. The IPEF model has pointed out that the local decision makers, through the adoption of a regional growth policy, have an opportunity to significantly effect the quality and quantity of growth in the San Diego Region.

In preparing the IPEF model, primary consideration was given to the notion that certain policies made on the regional or local level have a significant influence on the rate of population and economic growth. The model, therefore, was designed to respond to a variety of alternative policies. It has been used to test the impact of policies relating to such factors as the unemployment rate, family planning, health care, and industrial expansion. In addition, it recognizes certain factors which are beyond the influence of local policy decisions. These include such things as the level of military personnel stationed in the Region and the growth of the national economy.



UNEMPLOYMENT RATES

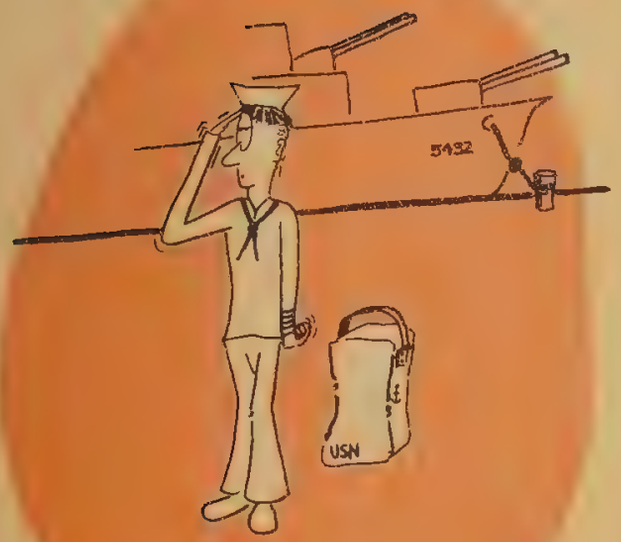


FAMILY PLANNING

LEISURE WORLD

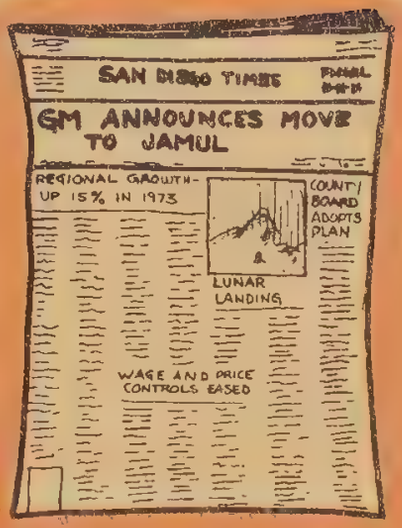
RETIREMENT MIGRATION

CHANGES IN CRITICAL FACTORS AFFECT THE REGION'S GROWTH



MILITARY MIGRATION

HEALTH CARE SERVICES



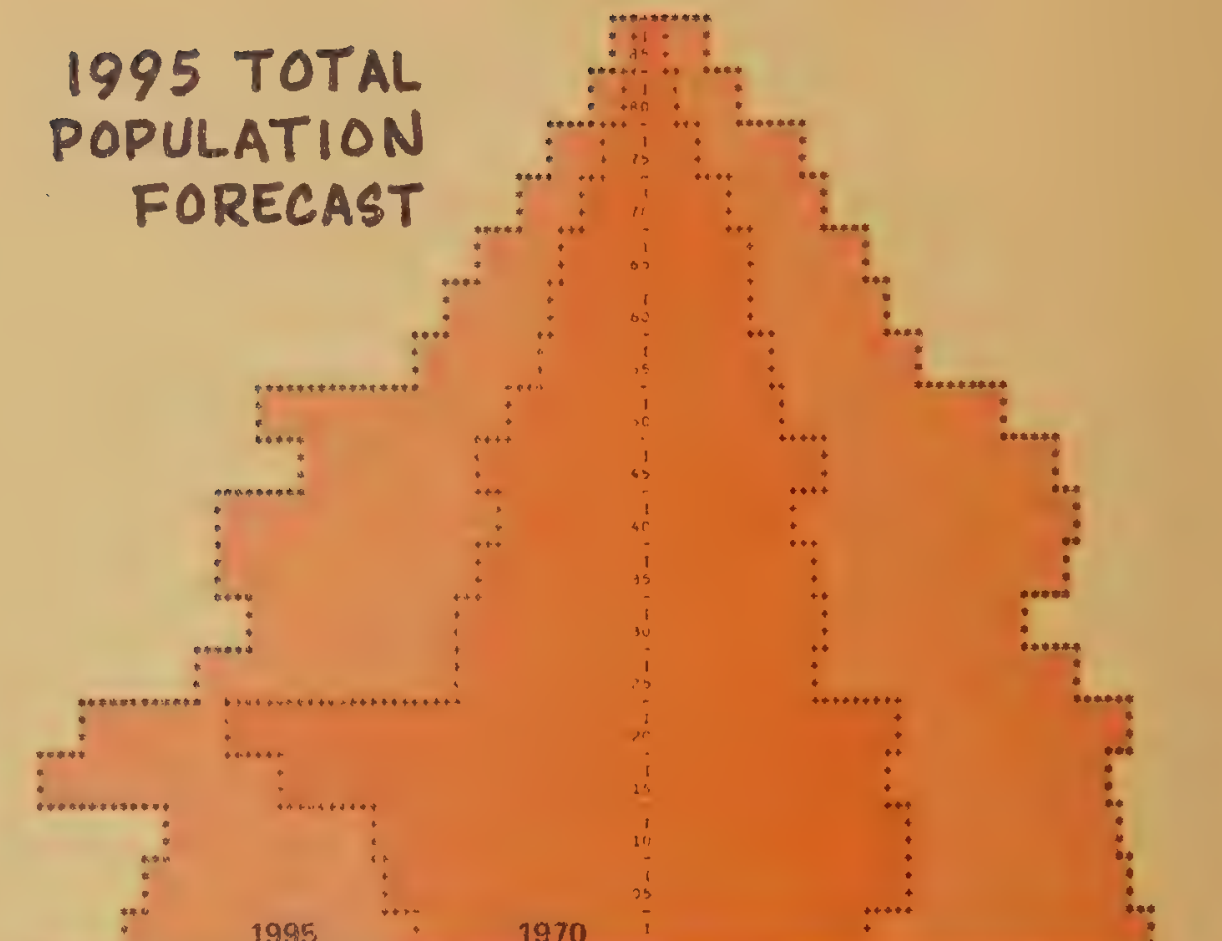
INDUSTRIAL EXPANSION

IPEF population forecasts are based on five components of regional growth:

(1) births,
(2) deaths,
(3) employment-related migration,
(4) military-related migration, and
(5) retirement-related migration.

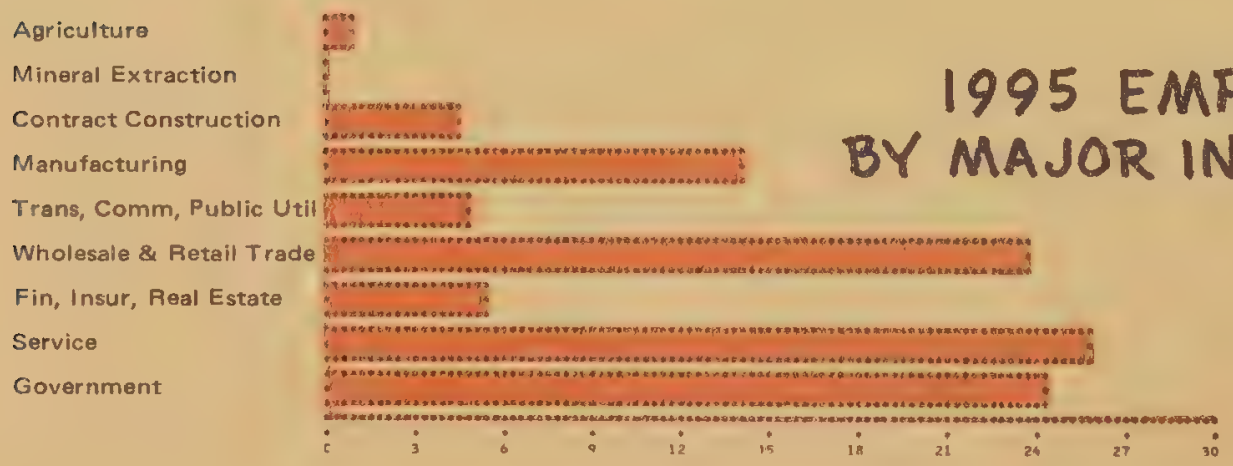
Each component is simulated according to specified assumptions and policy alternatives. The model 'output' consists of forecasts of population by age, race, and sex and employment by industry for each five-year interval in the forecast period. The accompanying graphs represent examples of some of the more generalized output or products from the IPEF model. Each of these graphs was produced directly by the IPEF Computer model. They represent summaries of 1995 employment and population forecasts which were prepared under a "rapid growth" assumption.

1995 TOTAL POPULATION FORECAST

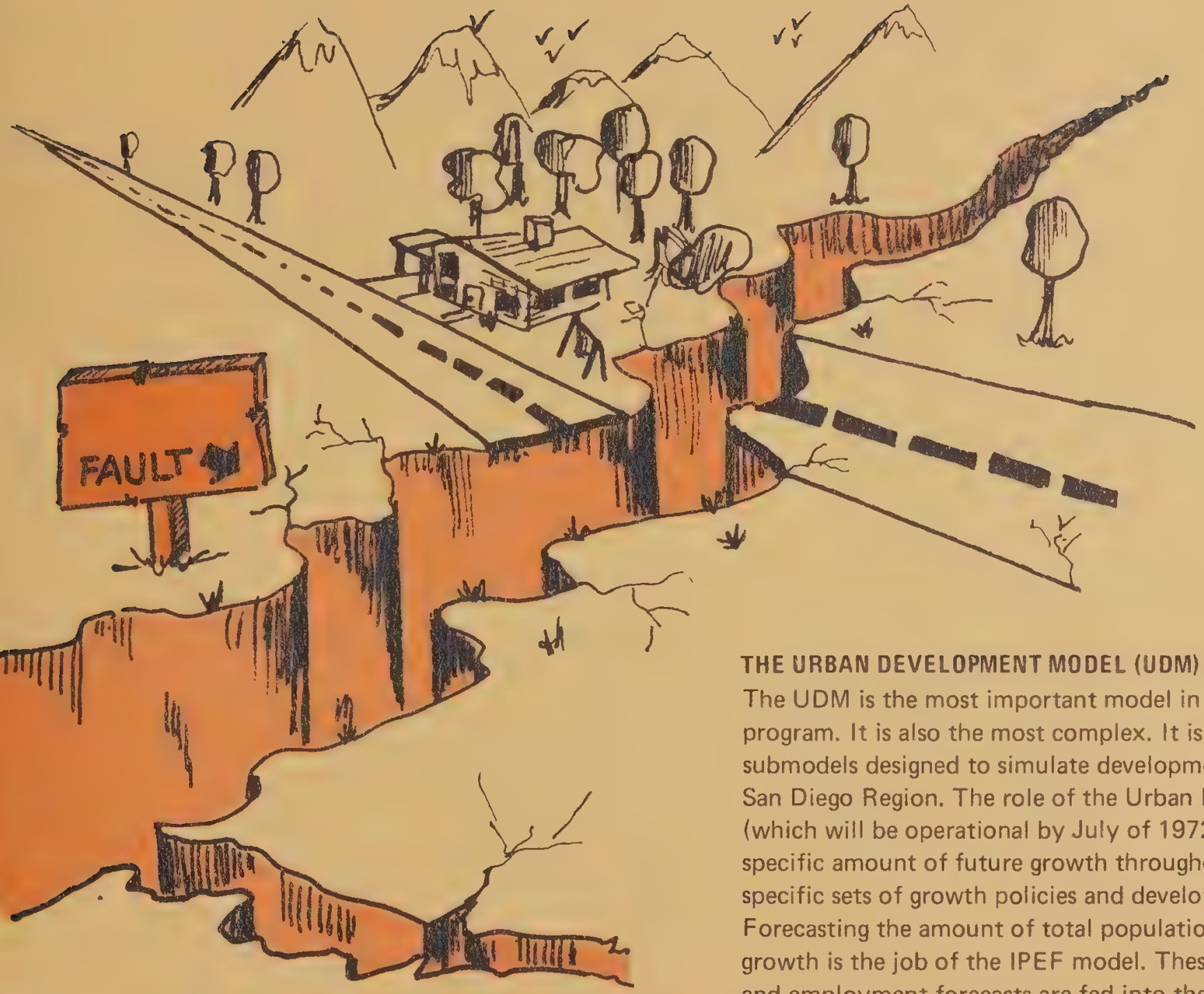


Population in Tens of Thousands by Age and Sex

1995 EMPLOYMENT BY MAJOR INDUSTRY GROUPS



Employment in Tens of Thousands



THE URBAN DEVELOPMENT MODEL IS SENSITIVE TO ENVIRONMENTAL CONSTRAINTS.

THE URBAN DEVELOPMENT MODEL (UDM)

The UDM is the most important model in the regional planning program. It is also the most complex. It is actually a system of submodels designed to simulate development patterns in the San Diego Region. The role of the Urban Development Model (which will be operational by July of 1972) is to distribute a specific amount of future growth throughout the region given specific sets of growth policies and development constraints. Forecasting the amount of total population and employment growth is the job of the IPEF model. These regional population and employment forecasts are fed into the UDM to be distributed geographically. The UDM focuses on the incremental growth and identifies where within the Region the growth is likely to occur.

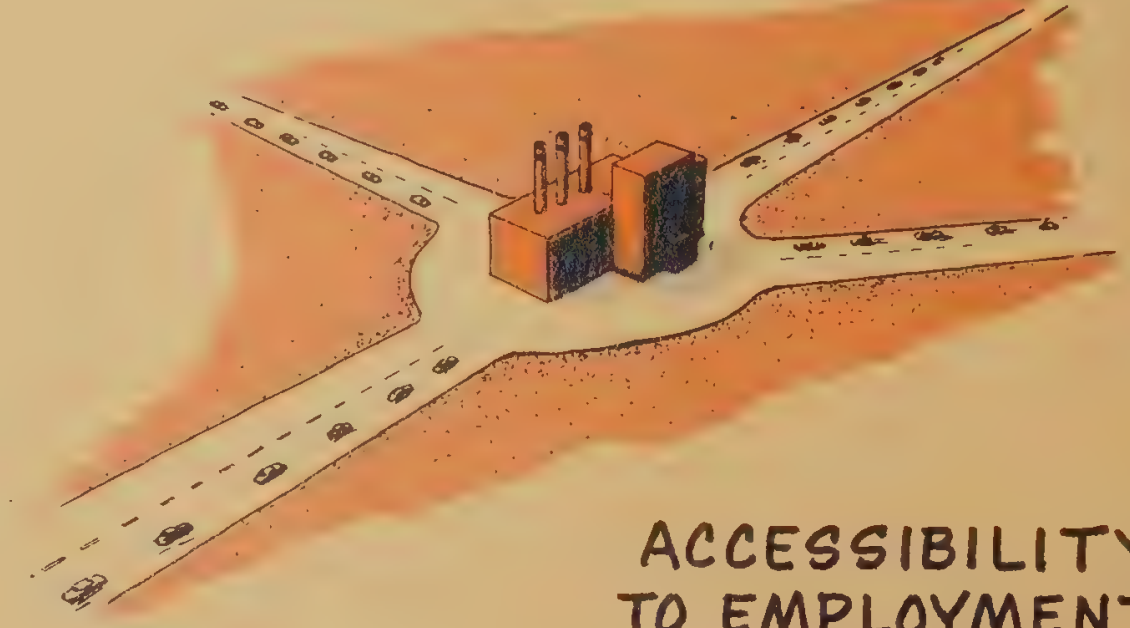
HOW DOES THE UDM WORK?

The UDM involves a fairly complex set of calculations. The basic notions upon which it operates, however, are quite simple. The model considers that there are three overriding factors which determine where development will occur within the region:

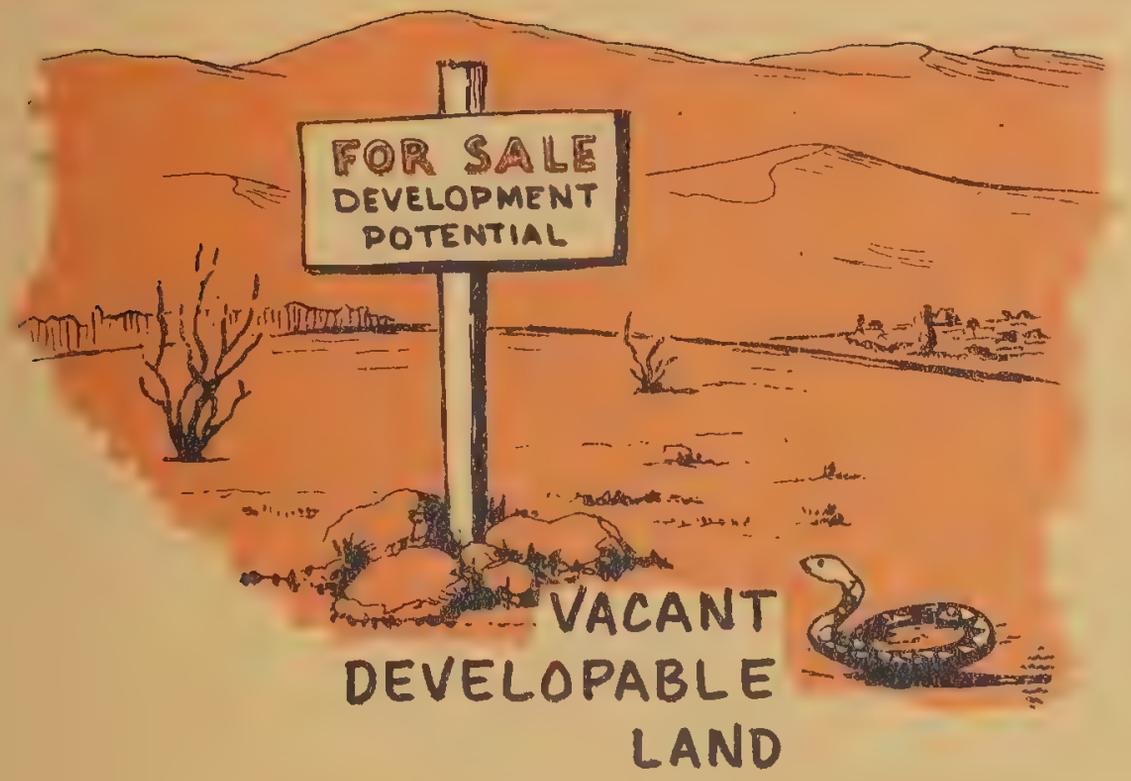
(1) The accessibility to employment opportunities;
(2) The availability of developable land in which residents may locate, and;
(3) The 'attractiveness' of any given area.

'Accessibility' represents the time it takes to get to and from various activities throughout the region (e.g. work, shopping, recreation). Obviously, different individuals place different importance on the desirability of living close to work or recreation areas. But these different attitudes toward commuting are, to a degree, predictable in an overall regional context. For example, it might be observed that 30 percent of the population may desire to live within 15 minutes of work while 10 percent are willing to endure a 35 minute commute. Both commuting patterns and the travel times possible on the transportation system are considered by the Urban Development Model.

DEVELOPMENT POTENTIAL IS DETERMINED BY THREE PRIMARY FACTORS



ACCESSIBILITY TO EMPLOYMENT



The 'Availability of Vacant Developable Land' in any particular area is also given important consideration. These locational opportunities reflect the potential for development existing in any given area. It is expressed in terms of land area which is available for development. Residential densities and open space policies are important in determining the location and amount of vacant developable land.

The 'Attractiveness' of an area is also a factor considered by the Urban Development Model to determine where development will occur. Certain locations, for a number of reasons, have uniquely desirable characteristics which serve to attract development. These features include proximity to the coast, attractive view, prestige neighborhoods, and the like. These factors tend to be embodied in the existing housing values, which become a proxy for attractiveness.

These three elements--accessibility, availability of vacant land, and attractiveness--are combined in the 'allocation function', the mathematical equation expressing the relationship between these elements and future development within the Region.

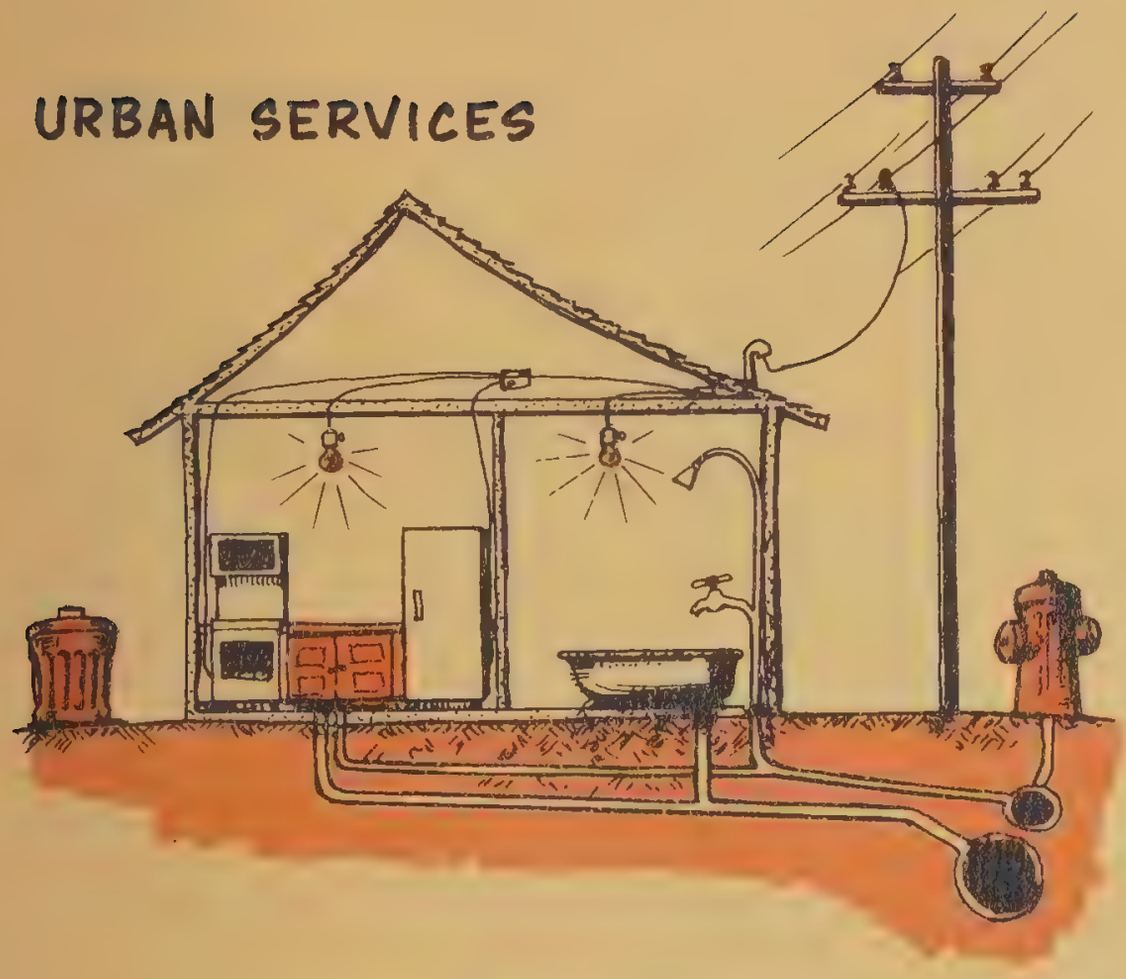
WHAT KIND OF POLICIES DOES THE UDM CONSIDER?

The Urban Development Model is primarily a tool for testing alternative policy choices. The policies to which the model is sensitive are those that have an influence on accessibility, availability of vacant developable land and attractiveness. The policies are discussed below under the headings of (1) transportation system, (2) urban governmental services, and (3) land use constraints.

(I) Transportation System -- It is widely agreed that the transportation system is the single most important factor shaping the urban environment. Policies concerning the nature and routing of the transportation system will shape development in the years to come. A new freeway, for example, is likely to attract development, unless other factors, such as land use constraints, intervene. The relevant factors are the travel times that can be achieved on the transportation system and the costs associated with alternative modes of travel.

CERTAIN REGIONAL POLICIES ARE IMPORTANT GROWTH DETERMINATES

TRANSPORTATION SYSTEMS



(2) Urban Governmental Services -- Within the Urban Development Model framework, governmental services refer specifically to the availability of municipal water and sewer services. If these are not available, development will normally be limited to low residential densities. On the other hand, public decisions to provide these services usually signal a green light for development to proceed.

(3) Land Use Constraints -- The most commonly used control on development has been land use constraints. A variety of land use constraints are considered in the Urban Development Model. It accounts for land being withheld from development because of unsuitable soil conditions or topographical features, such as excessive slope. It also considers land that is earmarked for particular uses, such as land designated as public open space, agricultural preserves, or military reservations and is unavailable for residential development. In addition, the Urban Development Model takes account of density constraints imposed by local government.

THE U.D.M. CONSIDERS THE INTERRELATIONSHIPS BETWEEN PRIMARY REGIONAL FUNCTIONS.

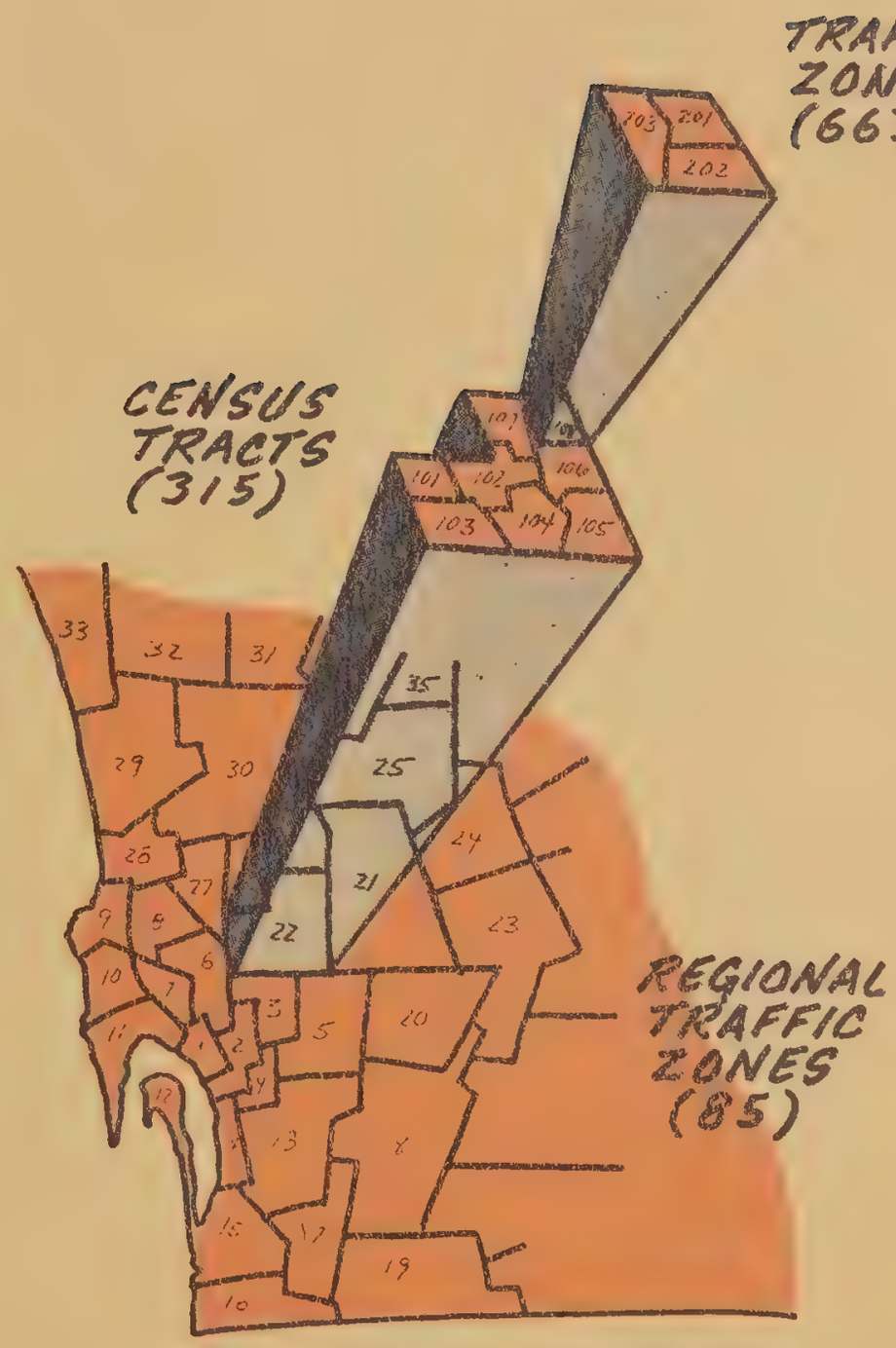
WHAT DOES THE UDM FORECAST?

The primary function of the UDM is to indicate the way in which the Region is likely to develop under a variety of alternative policies. The following information is provided as output from the Urban Development Model by small geographic units:

(1) Total population and dwelling units.
(2) Employment by place of work and at place of residence.
(3) Total land use acreage by type of use.
(4) Household income.
(5) Housing values.
(6) Property, sales, and income tax revenues.

The above information forms the economic and land use profile for each geographic unit throughout the Region. Depending upon the level of detail required, the Urban Development Model will forecast future growth for a variety of geographic units. Traffic zones form the smallest geographic unit for which forecasts are produced. (There are 663 traffic zones in the San Diego County Region). The Urban Development Model will also produce forecasts for Census Tracts (315), and regional traffic zones (85).

The following pages are examples of output or products from the Urban Development Model. Each of these maps was prepared using various computer mapping systems which are part of the Regional Information System. These mapping tools represent one of many techniques that are being developed to assist in describing and analyzing the forecasts that will be prepared via the regional model system.



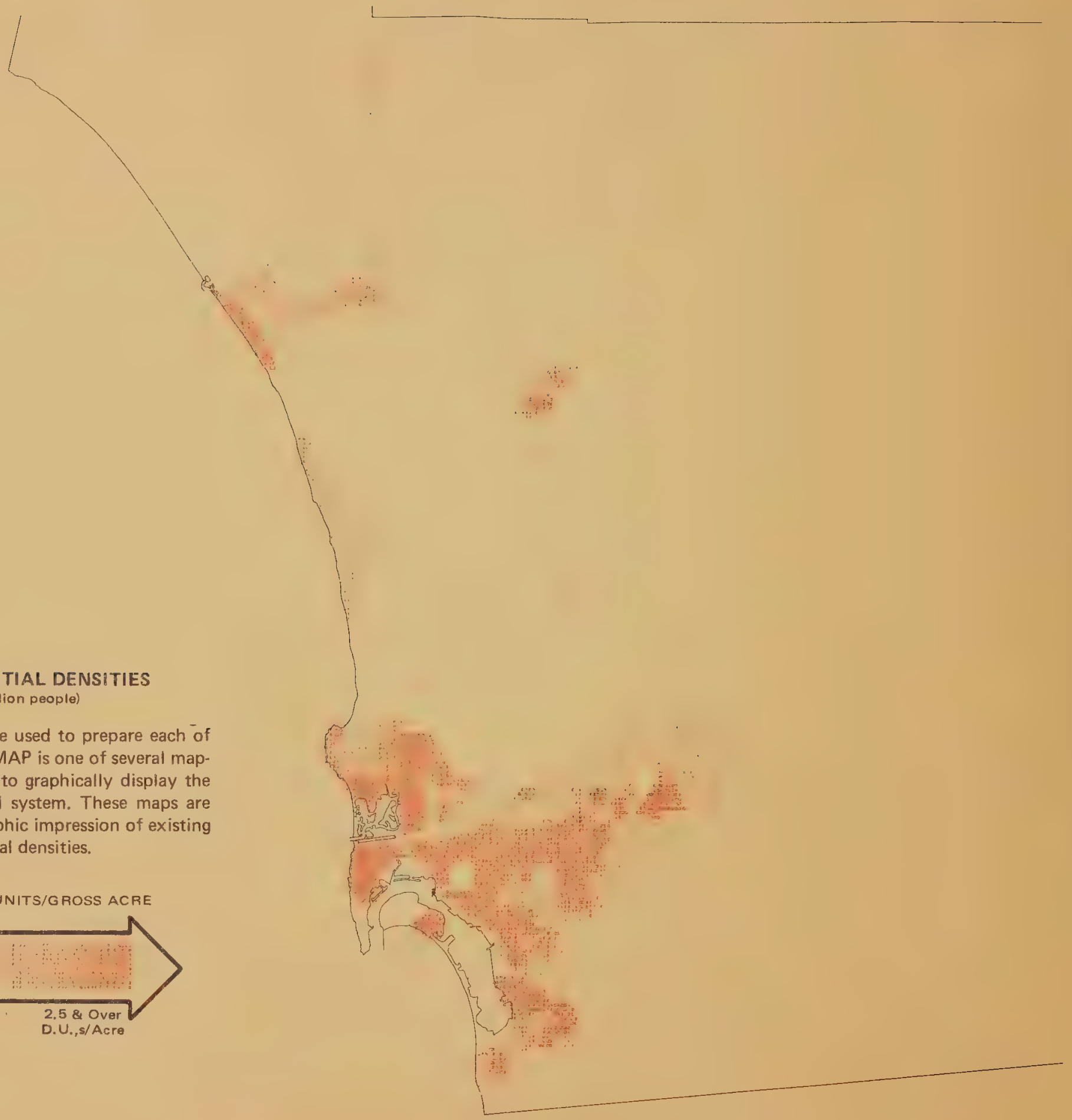
FUTURE GROWTH CAN BE FORECAST FOR A VARIETY OF GEOGRAPHIC UNITS

1970 EXISTING RESIDENTIAL DENSITIES

(1970 Census - 1.4 million people)

The computer mapping technique used to prepare each of these maps is called SYMAP. SYMAP is one of several mapping systems which will be used to graphically display the output from the regional model system. These maps are intended to provide a general graphic impression of existing and possible future gross residential densities.

RESIDENTIAL DWELLING UNITS/GROSS ACRE

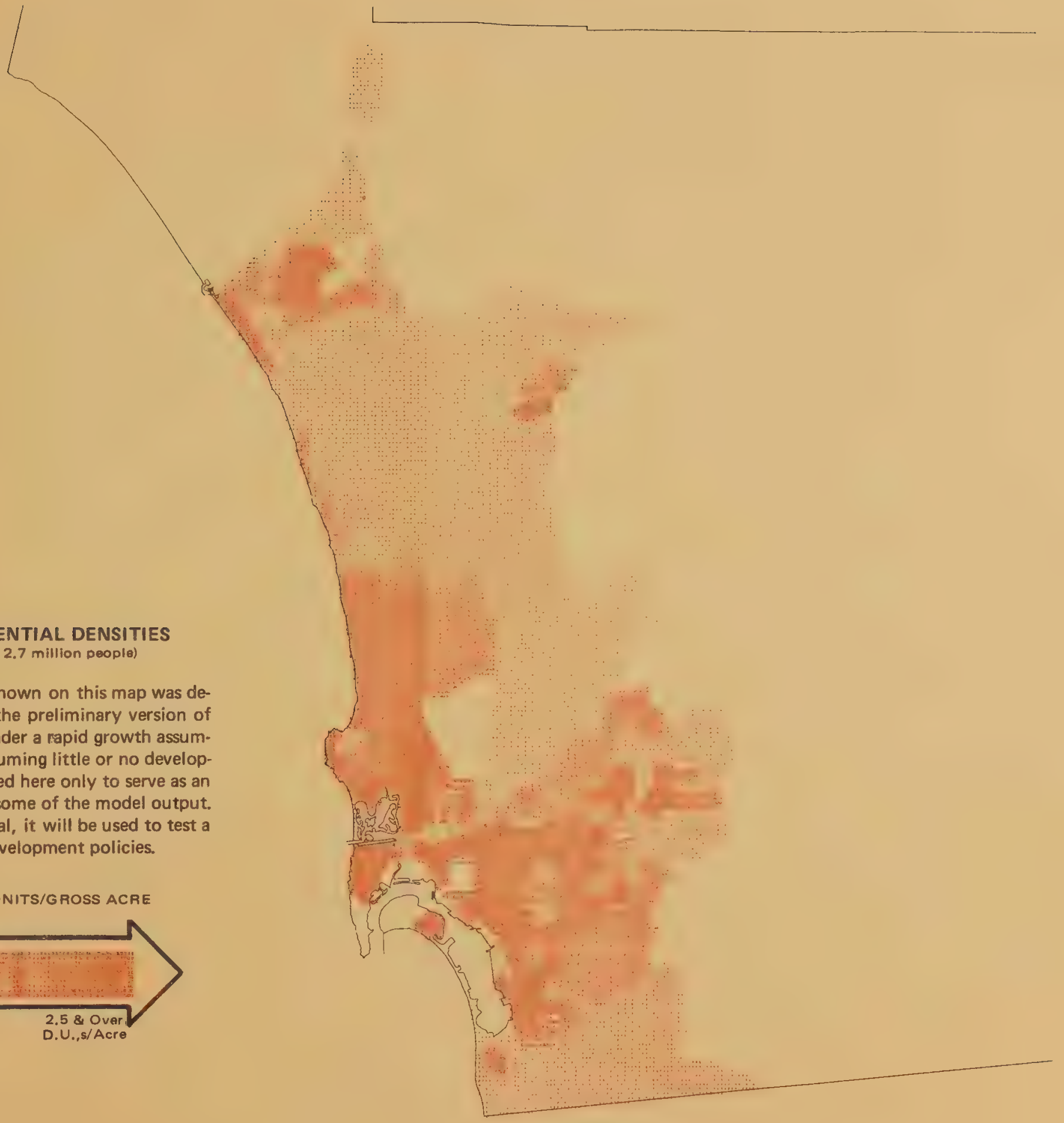


1995 FORECASTED RESIDENTIAL DENSITIES

(Rapid Growth Assumption - 2.7 million people)

The 1995 residential pattern as shown on this map was derived from an initial test run of the preliminary version of the Urban Development Model under a rapid growth assumption (2.7 million people) and assuming little or no development controls. This map is provided here only to serve as an example of the type and form of some of the model output. Once the UDM is fully operational, it will be used to test a variety of growth concepts and development policies.

RESIDENTIAL DWELLING UNITS/GROSS ACRE



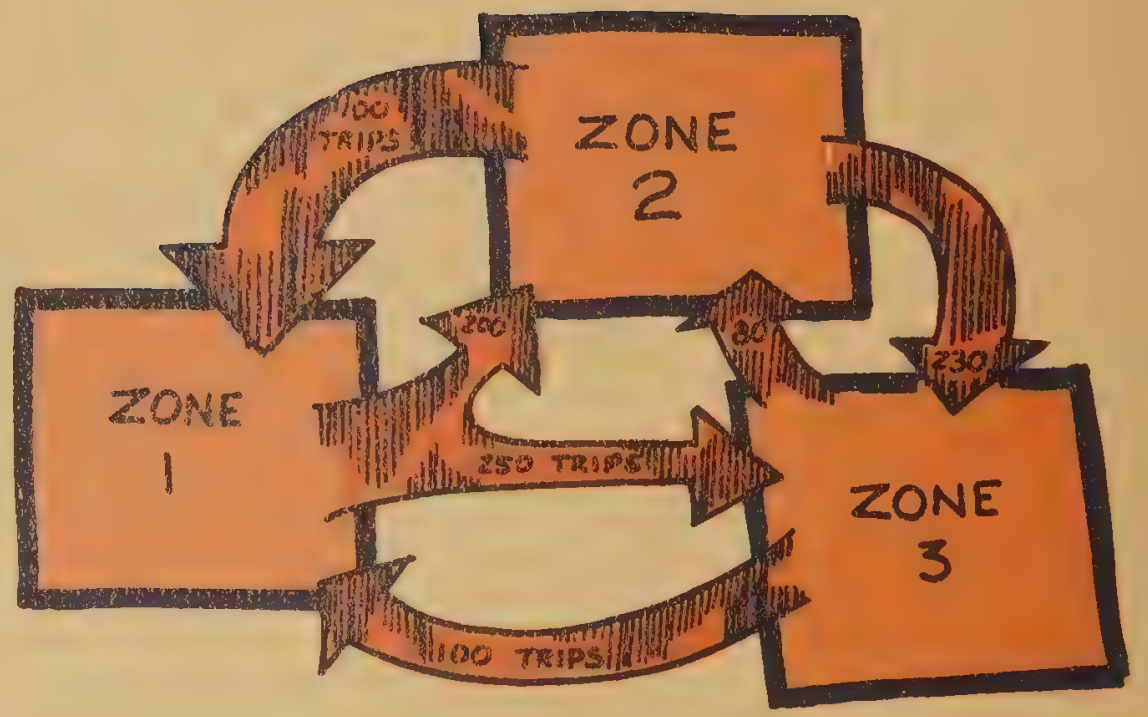
TRANSPORTATION MODELS

The Transportation models are designed to simulate traffic patterns on each major segment of the transportation network. This is done by using a detailed description of the transportation system - including speeds, distances, costs and travel times - and the economic, social, and land use characteristics derived by the Urban Development Model. There are four individual models in the Transportation Model System:

(1) Trip generation,
(2) Trip distribution,
(3) Mode split, and
(4) Assignment.

1. The Trip Generation Model involves estimating the number of trips originating or ending in any given location (traffic zone). This is done by considering the number and characteristics of the residents and employees at each location. (This model is operational at the State Division of Highways)

TRIP GENERATION



TRIP DISTRIBUTION

2. Trip Distribution is the process by which the trips generated by the trip generation model are connected or linked together. Whereas the generation model identifies only the number of trips beginning or ending at any location, the distribution model identifies where the trips are coming from or going to. (The Distribution Model is operational at the State Division of Highways)

3. Mode Split identifies the transportation modes (e.g. automobiles, bus, rapid transit) used to make the trips. The modes used depend on the trip purpose (e.g. work trip, shopping trip), the characteristics of the transportation system (e.g. costs, travel times, convenience), and the characteristics of the users (e.g. income, age, occupation). (The Mode Split Model will be operational in July of 1972.)

TRIPS ARE ASSIGNED TO VARIOUS MODES.

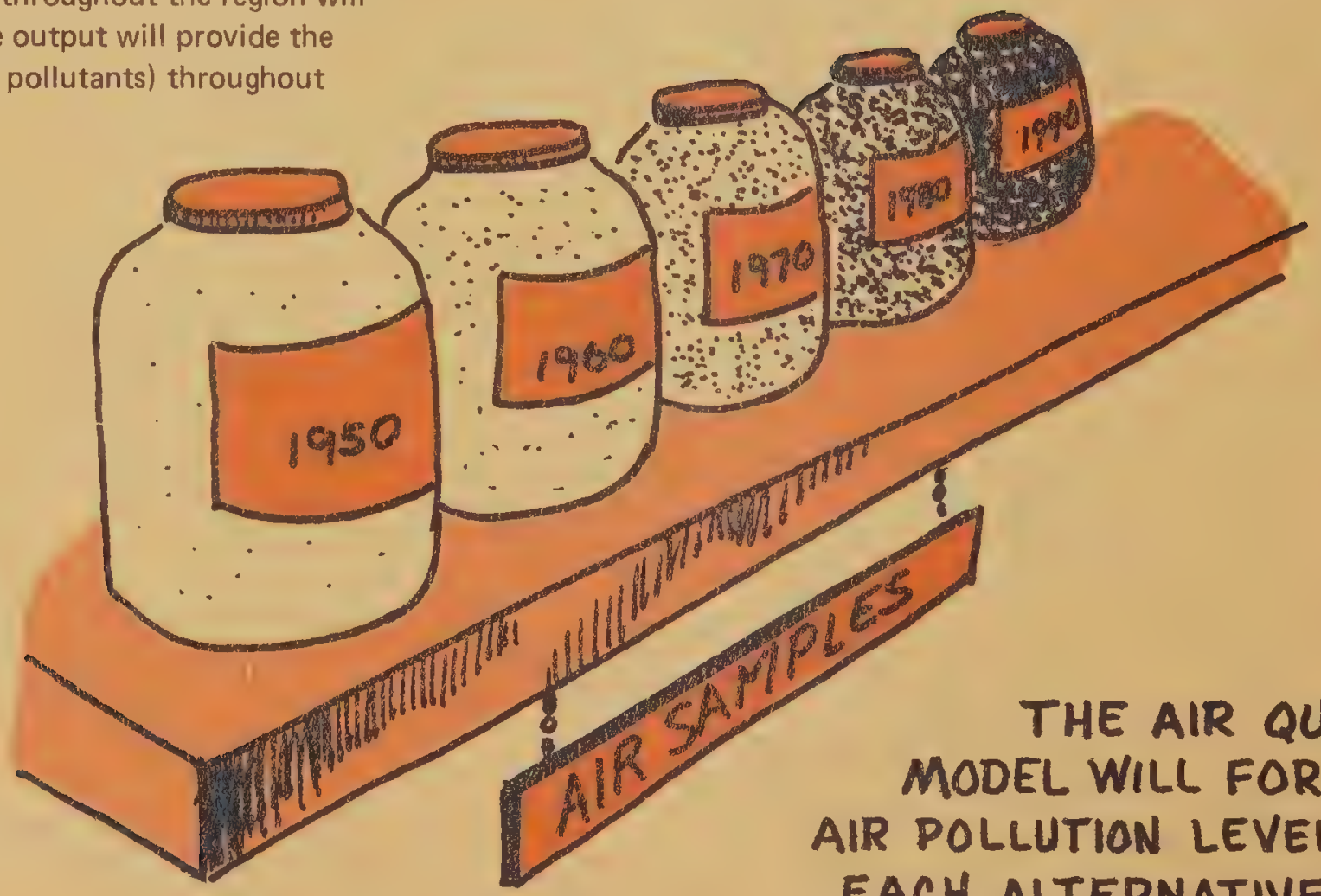
4. Trip Assignment is the process of identifying the route on the transportation system by which each trip will be made. Trip assignments to the transportation network are made based on the assumption that people will choose the fastest available route to their destination. (This model is operational at the State Division of Highways)

ASSIGNMENT OF TRIPS WITHIN A GIVEN SYSTEM IS BASED ON TRAVEL TIME

The information obtained from the transportation models indicate how the major transportation facilities will be used in the future. It shows, for example, how much traffic can be expected on a proposed freeway, or how much use a proposed rapid transit system will receive under each land use concept. It shows where existing or proposed transportation facilities will be operating above or below capacity. An analysis of the output from the transportation models will allow the system to be re-designed so it will accomodate the expected future travel demands.

STRATEGIC AIR QUALITY MODEL (SAQ)

The SAQ Model is still 'on the drawing board' and will not be operational until late 1972. This model (Being developed under the auspices of the County's Integrated Regional Environmental Management (IREM) Project.) will describe future air quality, based on stationary and mobile sources of pollution, and the meteorological characteristics of the Region. The Urban Development Model will provide much of the information concerning the location of stationary sources of pollution (primarily industrial facilities and power generating plants) and the transportation models will identify the location of the mobile sources of pollution (e.g. cars, trucks, buses). The way in which these pollutants are dispersed throughout the region will be described by the SAQ Model. The output will provide the expected air quality (level of various pollutants) throughout the region.

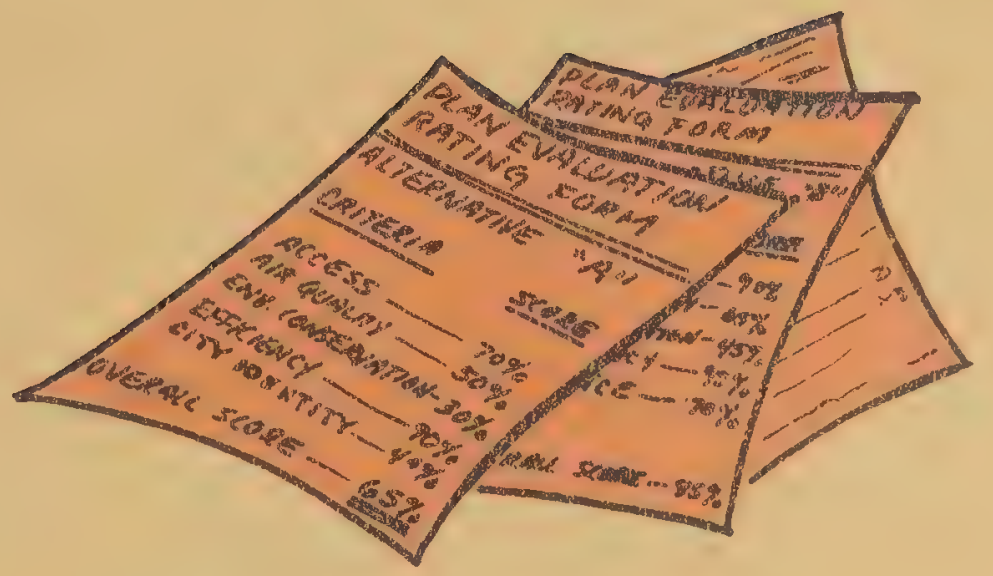


THE AIR QUALITY MODEL WILL FORECAST AIR POLLUTION LEVELS FOR EACH ALTERNATIVE PLAN.

THE PLAN EVALUATION METHOD

The model system developed for the CPO program activity is designed to simulate alternative futures for the San Diego Region under a variety of alternative policies. The models will provide detailed information concerning population, housing, employment, land use, transportation and environmental quality. The mass of information produced by the models will serve as the basis for identifying the set of policies that leads to the most desirable situation in the future. To help identify the best plan, the 'plan evaluation method' will relate the data developed by the model system to predetermined criteria, to determine how well each plan or choice meets the goals for the San Diego Region.

THE PLAN EVALUATION METHOD WILL RESULT IN THE SELECTION OF THE BEST ALTERNATIVE PLAN.



EACH ALTERNATIVE PLAN WILL BE EVALUATED BASED UPON ESTABLISHED CRITERIA.

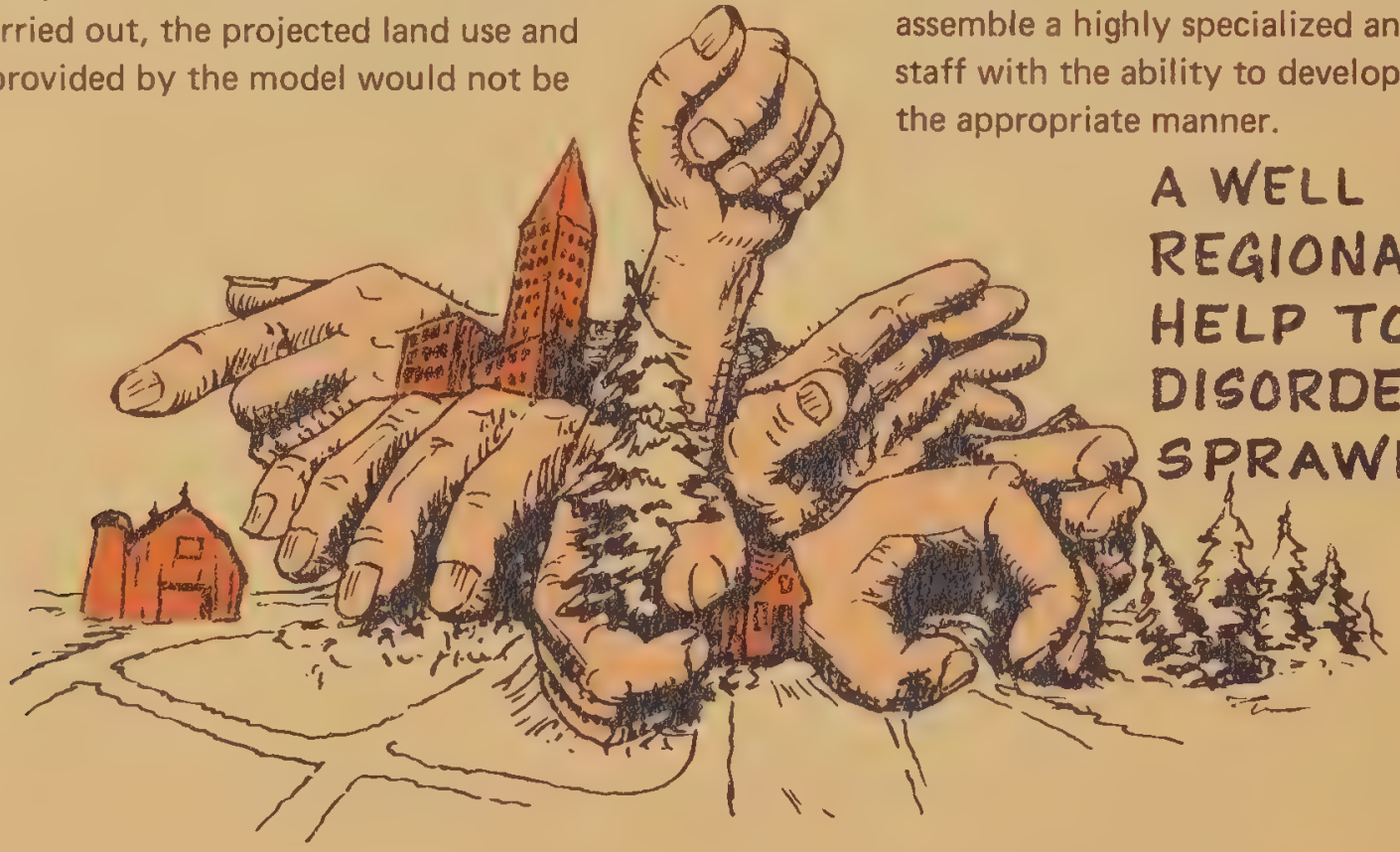
The criteria for evaluation will be related to the key issues and problems in the Region. The Regional Goals Committee and the CPO standing committees will provide the primary evaluation criteria. This criteria will deal with a full range of technical, social, economic, environmental, land use, developmental, and other impacts, both positive and negative. The 'plan evaluation method' will describe the ability of each alternative plan to meet the criteria, and express that evaluation in terms of a common denominator so the plans can be compared.

It should be pointed out that planning models are not without limitations. In any forecasting system, assumptions must be made in order to forecast future events. For example, in forecasting future regional population and employment levels via the IPEF model, it was assumed that the national economy would not experience any drastic changes from historical patterns. If, for example, the national economy were to experience a significant and unforeseen increase in productivity and growth, the IPEF model forecast would require adjustments to account for this trend.

The forecasts derived from the Regional model system are also predicated upon various policy assumptions. The UDM, for example, is specifically used to test the effects of alternative regional policies on land use and transportation patterns. If these implied policies in any one of these alternative forecasts were not adopted and carried out, the projected land use and transportation patterns provided by the model would not be achieved.

Lastly, planning models, like any other forecasting technique, are highly dependent upon accurate and reliable information. If significant errors are inherent in the data base upon which forecasts are being made, these errors will be reflected in the final projections. Moreover, if relationships between various dynamic forces within the urban growth environment are not properly defined, the resultant forecasts will not be entirely reliable.

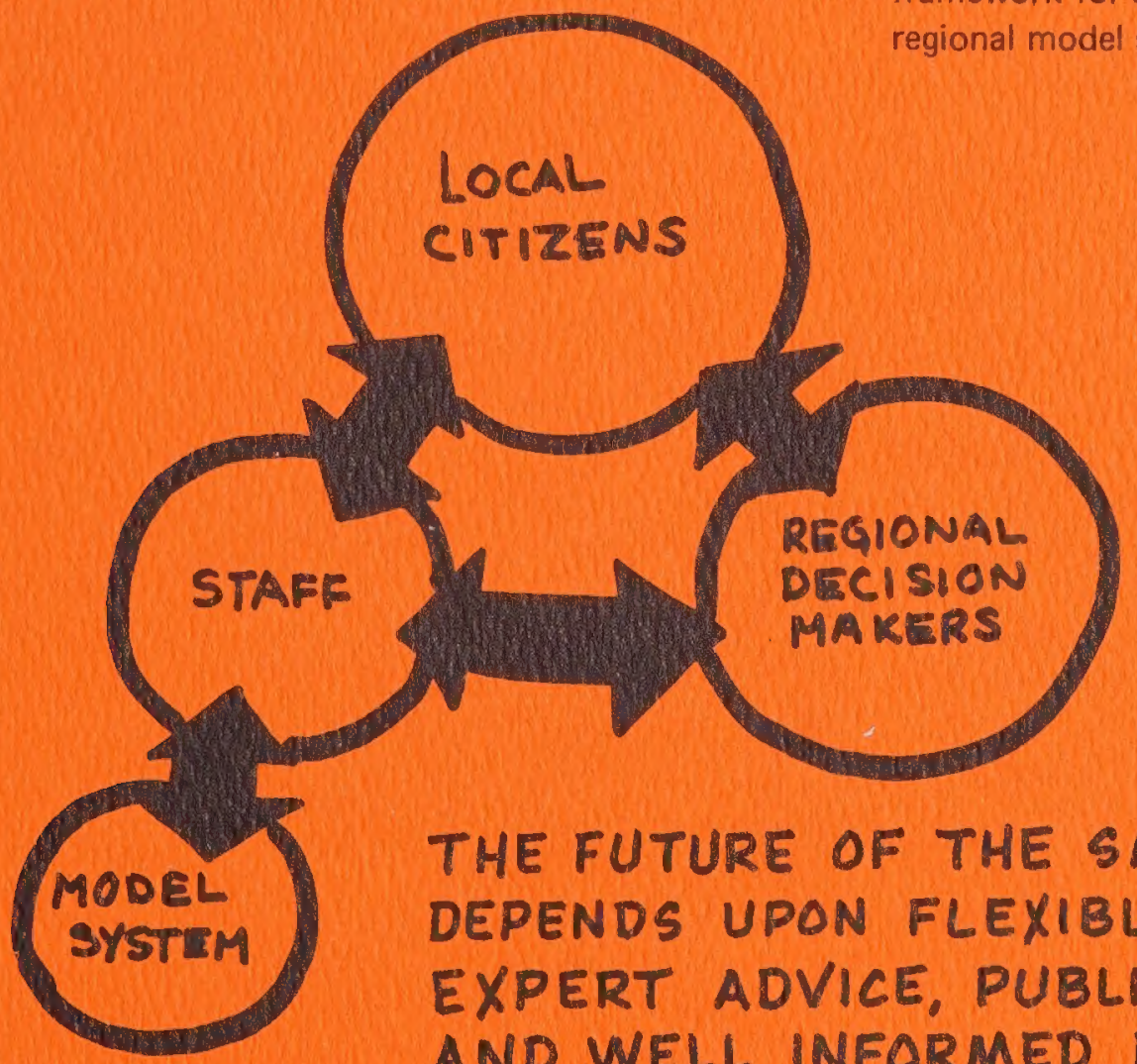
The limitations mentioned above are inherent in any method of projecting alternative future events or situations. Through the use of models, many of these difficulties can be overcome or minimized. In order to achieve a truly viable forecasting system in the San Diego County Region, a great deal of reliance has been placed upon the use of reliable and well tested methods. Moreover, every effort has been made to assemble a highly specialized and technically competent staff with the ability to develop and employ these models in the appropriate manner.



SUMMARY

In summary, the system of models currently being developed and applied to the San Diego County Region represents a significant attempt to formulate a fully integrated and analytically sound comprehensive Regional Plan. The regional modeling system represents an understanding and acknowledgement of the fact that the development and adoption of a regional plan MUST be based upon the most accurate and sound information possible. The public investment devoted to developing and applying these modeling tools represents a minor cost when compared to the consequence of hasty or ill-informed development decisions.

If the San Diego Region is to have a major mass transit system, that system must be based upon sound planning principles and accurate information. If this transportation system is to both shape and serve regional land uses in an effective manner, it must be designed and tested in an integrated fashion. If the region hopes to achieve a balance between sound development practices and harmony with the natural environment, every effort must be made to integrate environmental considerations into the plan making process. An obvious and mandatory prerequisite to achieving these and many other regional goals, is the availability of a highly flexible and technically sound framework for analysis. This framework is provided by the regional model system.



THE FUTURE OF THE SAN DIEGO COUNTY REGION DEPENDS UPON FLEXIBLE ANALYTICAL TOOLS, EXPERT ADVICE, PUBLIC AWARENESS, AND WELL INFORMED DECISIONS!